SPORTS DIETITIANS AUSTRALIA

FACT SHEET
PROTEIN AND AMINO ACID SUPPLEMENTATION

There is probably no other nutrient that has captured the imagination of athletes more than protein. Recent interest in the virtues of protein for both fat loss and muscle gain has ensured athletes, both endurance and strength focused, to have taken a keener interest in their protein intake. This heightened interest has also stimulated a flourishing protein supplement industry which has been very cleverly marketed. Given this, it shouldn't come as a surprise that protein and amino acid supplements remain some of the most popular dietary supplements among athletes and fitness enthusiasts.

PROTEIN NEEDS OF ATHLETES… IS SUPPLEMENTATION WARRANTED?

There is now little doubt that hard training athletes have higher protein needs than their sedentary counterparts, perhaps 50-100% greater than dietary guidelines advocated for the general public. To the ill-informed, this may be justification enough to support the use of protein and amino acid supplements. However, because athletes generally have a generous appetite and protein is so widely distributed in the meal plan, most athletes easily achieve their elevated daily protein intake targets. So if athletes are more than adequately achieving their daily protein needs without supplementation, how can the use of a protein supplement be justified?

Generic dietary guidelines are unlikely offer insight into optimisation of dietary protein intake to support functions pertinent to hard training athletes such as repair of exercise-induced muscle damage and stimulation of muscle hypertrophy. Rather, consideration should be given to the nutritional value of the protein and its distribution throughout the day if these functions are to be optimised.

PROTEIN QUALITY AND TIMING

The nutritional value of proteins varies markedly depending on their constituent amino acid profile and digestibility. Animal sourced proteins such as that from milk (and its constituent proteins casein and whey), eggs and most meats are considered high biological value (HBV); that is, they contain large amounts of essential amino acids in a form that is readily digested. Amongst plant based foods, isolated soy protein is also considered to be of high value, so long as its anti-nutritional factors are removed. While there are a large number of amino acids derived from the foods we eat, it is only the essential amino acids (ones our body cannot make itself and thus must come from the diet) that are required to facilitate many of the functions important to athletes.

The individual amino acids produced during the metabolism of dietary proteins serve as both a substrate for building other dietary proteins as well as a trigger for activating various metabolic processes. Amongst athletes interested in muscle hypertrophy, amino acids, and specifically leucine, play a critical role in stimulating muscle protein synthesis. The leucine content of foods varies markedly but some foods are naturally high in leucine, including milk and meat proteins. Financial support of the dairy industry has facilitated significant research into the value of dairy proteins. Dairy protein is compromised mainly of casein (80%), with smaller amounts of whey (20%). It is the whey protein which is particularly high in leucine. Not only is whey high in leucine but it's also digested at a much faster rate than casein, ensuring blood leucine levels peak soon after ingestion, turning on the protein synthetic machinery responsible for building muscle. Recent research suggests that the combination of a HBV protein rich in leucine that is rapidly digested results in more favourable muscle hypertrophy compared to other proteins such a whole milk protein, slowly digested casein and soy protein.

It appears that a leucine dose of 2-3 grams maximally stimulates protein synthesis. Amongst HBV protein-rich foods like meats and dairy, this coincides with an individual protein serve of ~20-25g, which recent research has shown to maximally stimulate protein synthesis, with amounts in excess merely stimulating protein oxidation and thus offering no further benefit. Table 1 describes an array of foods in amounts that provide a 2 g dose of leucine, which generally coincides with a 20-30 g serve of protein. Perhaps not surprisingly, HBV protein foods are the most energy efficient choices when aiming to maximally stimulate protein synthesis. While whey protein clearly provides the 'biggest bang for your buck', strategic selection of specific foods or combinations of different foods at meals and snacks throughout the day will not only result in optimisation of protein intake but also contribute to achieving other essential nutrient needs.

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For example, each of the following selections provides 20-30g of high quality protein without the need for special dietary supplements:

BREAKFAST
- 3 egg omelette
- Bowl of cereal with 250 ml of milk plus a tub of yoghurt
- Fruit smoothie with 250 ml low fat milk, fruit, honey & 30g skim milk powder

LUNCH
- 60 g ham with 2 slices of cheese on sandwiches with salad

DINNER
- 120 g piece (raw) of fat trimmed beef, skinless chicken or seafood

SNACK
- Small tin of tuna on crackers with 1-2 slices cheese
- 600 ml flavoured milk
- 2 tubs of flavoured yoghurt

Recent research suggests there may be advantages to the inclusion of these HBV proteins in the acute post-exercise period when the body has a heightened sensitivity to dietary protein. While less is known about optimisation of protein intake outside of the immediate post-exercise period (upwards of 3 hours after exercise), it makes good sense to include a small serve of protein rich food at all meals and snacks throughout the day, as described in the examples above.

Given that appetite can be suppressed acutely post exercise, the use of a rapidly digested whey-derived protein supplement may be advocated post-exercise, especially among those athletes where a pleasant tasting, easily prepared shake at the training venue is more convenient. The decision to use a protein supplement during this time should be based on several issues relevant to the individual athlete, including their training load and goals, daily energy requirements, typical diet, appetite post-exercise, budget available and general dietary intake. Outside of this period, athletes may be best advised to select small serves of high quality protein rich foods that will contribute to not only protein but also other nutrient goals.

PROTEIN SUPPLEMENTS….. HYPE OR HOT

The range of protein and amino acid supplements available can be quite confronting… caseinate, whey protein concentrate, whey protein isolate, egg albumin and more recently hydrolysed proteins as well as a wide range of individual and combination amino acid supplements. Protein supplements can be broadly classified according to their nutrient profile as either providing protein only (as a single protein source or a protein blend i.e. combination of several proteins) or a combination of protein and carbs with or without a range of proposed ergogenic ingredients such as creatine, specific amino acids and proposed fat metabolisers, plus vitamins and minerals. Protein-only supplements are typically 90% protein by weight, while those with added carbs can vary markedly with protein varying from as little at 10-15 g per 100g powder, to 50 or more grams. Use the guide below to better interpret the list of ingredients of commercially available protein powders:

- Whey Protein – HBV protein that is rapidly digested, comprising ~20% of dairy protein. Whey is rich in branched chain amino acids, especially leucine, the amino acid primarily responsible for stimulating protein synthesis. Recent evidence suggests that whey protein may offer greater satiety than other whole proteins, alluding to a potential role in weight loss as well as weight gain.

There are 3 main forms of whey protein:

  - o Whey Protein Concentrate (WPC) – Derived from the first filtering step in the production of whey protein isolate. Typically 70-80% protein by weight with small amounts of lactose (milk sugar) and fat. Cheaper than whey protein isolate
  - o Whey Protein Isolate (WPI) – Produced by further filtration of WPC, creating a powder that is ~90% protein by weight, with negligible amounts of carbs (lactose) and fat
  - o Whey Protein Hydrolysate (WPH) – Derived from WPC or WPI and characterised by shorter peptides or amino acid chains, supposedly resulting in even more rapid digestion and absorption, with an associated greater insulin response. Evidence to date is preliminary and conflicting. The process of hydrolysis ensures the powder is more expensive and bitter tasting.

- Casein or Calcium Caseinate – HBV protein that makes up ~80% of the protein in milk. Casein clots in the acidic environment of the stomach, slowing digestion and delivery of amino acids to the body. Casein hydrolysates are also available, resulting in a more rapidly digested and absorbed protein.

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- Soy Protein – HBV, rapidly digested protein. Some research suggests it may be preferentially utilised by the splanchnic system. As with whey, available as both a soy concentrate and soy isolate. Often used in mixed protein supplements, as well as protein bars as it is cheaper than whey. There is evidence to suggest that women with existing or previous breast cancer should be cautious in consuming large quantities of soy foods. The Cancer Council does not recommend or support the use of supplements such as soy protein.

- Egg Albumin – The go-to high quality protein source for supplements before the emergence of much cheaper dairy derived whey & casein proteins. A HBV protein source free of fat and carbohydrate.

Table 1. Various food/s required to provide 2 grams of leucine

Food	Amount	Protein (g)	Energy (KJ)	Cost
Milk (skim)	600 ml	22	900	$0.75
Soy beverage	900 ml	33	1600	$1.80
Milk Powder (skim)	60 g	22	880	$0.39
Cheese (reduced fat cheddar)	70 g	22	770	$1.10
Cheese (cottage)	140 g	25	530	$0.90
Yoghurt (skim, natural)	350 g	20	780	$1.82
Yoghurt (skim, flav.)	400 g	21	1290	$1.72
Whey Protein Isolate	17 g	16	290	$0.88
Egg (whole)	3 eggs	19	890	$0.73
Beef, poultry, seafood (raw)	120 g	25	640	$1.80
Almonds	130 g	26	3200	$2.60
Tofu	400 g	48	1900	$2.56
Kidney Beans (drained)	350 g	23	1300	$1.39
Lentils	380 g	18	820	$1.39
Bread	9 slices	28	3000	$0.84
Rice (white, cooked)	6 cups	26	6000	$1.42

Note: The protein and energy content of these foods is also provided for comparison, as well as their cost per serve (economy packs selected where available), based on data available on-line from a major supermarket chain on 22/05/2011.

While the addition of carbohydrate (typically as maltodextrin or dextrose) to a protein supplement does not appreciably impact on protein synthesis or breakdown, it does help meet other nutrition goals, especially if consumed in the acute post-exercise period when restoration of muscle glycogen stores may be a priority. The inclusion of other proposed ergogenic ingredients may do little else but add unnecessary expense to the product. Even for ingredients with proven performance potential such a creatine monohydrate, intake of these products may be best prescribed in isolation (i.e. pure creatine monohydrate supplement), rather than as part of a 'on stop shop' protein powder where individual dosing of active ingredients is not possible.

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Complementing the protein powders available the market, is an ever expanding range of protein bars and cookies. To facilitate the creation of a bar, variable amounts of carbohydrate and fat are required, with 'protein blends' typically used in preference to WPI to moderate costs. Taking information gleaned from very low calorie supplements, a bar is also likely to have higher satiety compared to a liquid, the implications of which will depend on the specific goal of the athlete. Irrespective, protein-rich bars and cookies remain an expensive option. There is also a wide range of amino acid powders available, including individual as well as mixtures of amino acids such as the branched chain amino acids. Evidence to date suggests there is little value in the prescription of individual amino acids.

ARE THERE ANY RISKS IN TAKING PROTEIN SUPPLEMENTS?

Debate continues in the literature on the health implications of the high protein diets currently popular amongst athletes and general society. Furthermore, health concerns have been raised about an overemphasis on protein derived from protein supplements. A report out of the USA on popular bodybuilding protein shakes suggests that regular intake (three servings a day) may result in exposure to heavy metals exceeding health guidelines, presumably because of contamination. Taken together, athletes are advised to firstly consider their intake of protein from whole foods, emphasising the inclusion of small amounts of high biological value protein at most meals and snacks throughout the day, to achieve both protein and other nutrient needs. When the convenience of protein supplements outweighs the cost, intake should be restricted to 1-2 serves a day at times when the ingestion of rapidly digested HBV proteins may be advocated, such as the immediate post-exercise period. Individual doses should be limited to an intake of no more than 20-30 grams.

TAKE HOME MESSAGE

The decision to use a protein supplement should only come after consideration of several factors specific to the individual athlete, including their training load and goals, lifestyle commitments, daily energy requirements, existing meal plan, appetite post-exercise, and available finances. If after giving consideration to these factors it is decided a protein supplement would assist in optimisation of dietary intake, careful consideration should be given to the specific supplement and its prescription. Current evidence indicates whey protein derived supplements offer superior benefit for athletes attempting to increase muscle mass. The selection of carbohydrate fortified protein supplements may be warranted in some situations but it is important to recognise this need can be met from readily available foods. HBV protein-rich foods that contain valuable amounts of other essential nutrients should be a priority when attempting to optimise nutrient intake. However, protein supplements may be of value when the delivery of rapidly digested proteins is a priority, such as the immediate post-exercise period. Liquid protein shakes may be particularly appealing to athletes who experience appetite suppression post-exercise. These products are also convenient when portable nutritional support is required. At other times, wholesome protein rich foods should be a priority, such as omelette at breakfast, cold meat, & cheese on sandwiches or fat trimmed, skinless chicken or seafood at dinner.

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